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A MINIATURE, HIGH EFFICIENCY VACUUM CLEANER FOR NAL BEAM TUBES

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There has been a fairly successful attempt to remove magnetic debris from the main ring vacuum tube by means of the bubble chamber magnetic dart. Unfortunately, ferret dropings as well as other debris such as stainless screws, pieces of baggies, fire extinguisher powder, etc. are not ferro-magnetic. The problem presented was to devise a vacuum cleaner that could fit into a beam tube; operate over a length of about a half mile and have sufficient suction. The use of a long hose on a conventional vacuum cleaner is not possible since it is impossible to maintain suction over a long length even with large diameter hoses.

The use of small electric motors to provide suction was abandoned due to power and air flow requirements. What we did exploit was the large, high pressure, high capacity pump used to push the dart through the main ring. The method finally used was to adapt to high pressure air the steam ejection pumps which are sometimes used to obtain high vacuum. A full description of these devices may be found in the literature.[1] Basically the device is a cross between an aspirator and a diffusion pump with high pressure gas as the working fluid.

Figure 1 shows several views of the vacuum cleaner head. Four ejection pump assemblies are connected in parallel. The basic unit consists of a convergent divergent nozzle, a mixing chamber where the suction port is located, and the diffusion through which the jet carries the entrained gas to the collection and exhaust area. At the end of the recieving area is a filter for collecting small chaff and a deflection head. The deflection head is designed to provide a turbulent scrubbing stream directed back towards the suction ports.

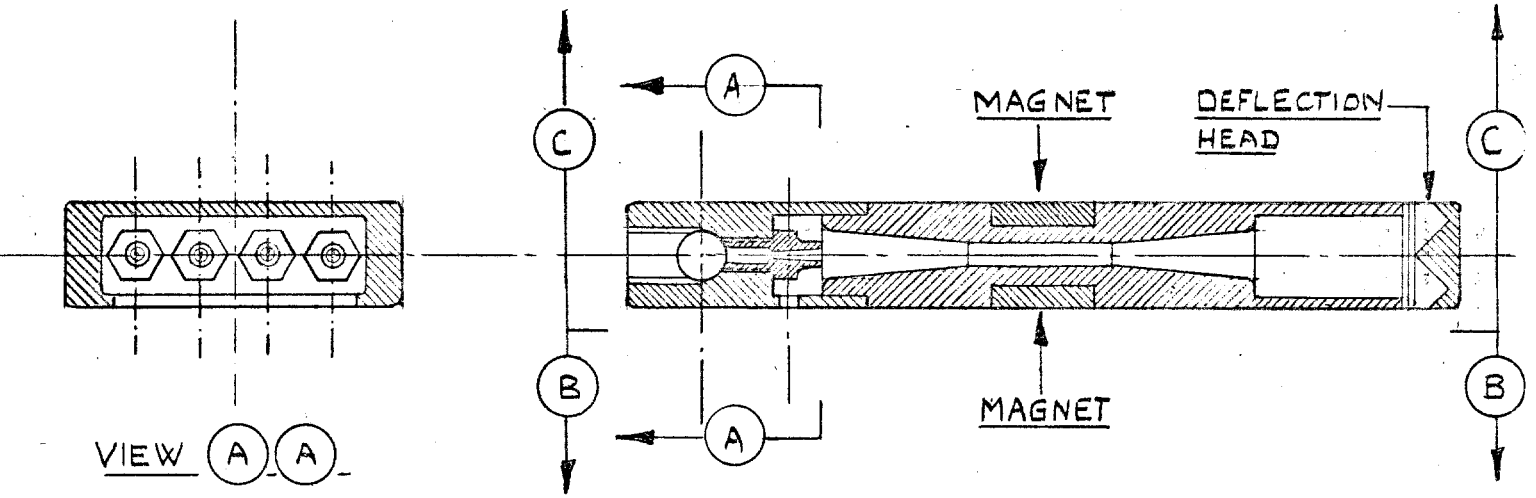
Magnets are provided along the top and bottom of the heads to pick up magnetic particles.

A high pressure source is required. The cleaning head will work from an input pressure range of 50 to 150 psi. The efficiency increases with increasing pressure. The head consumes air or other high pressure gas at a rate of 10 CFH at pressure. Therefore one may

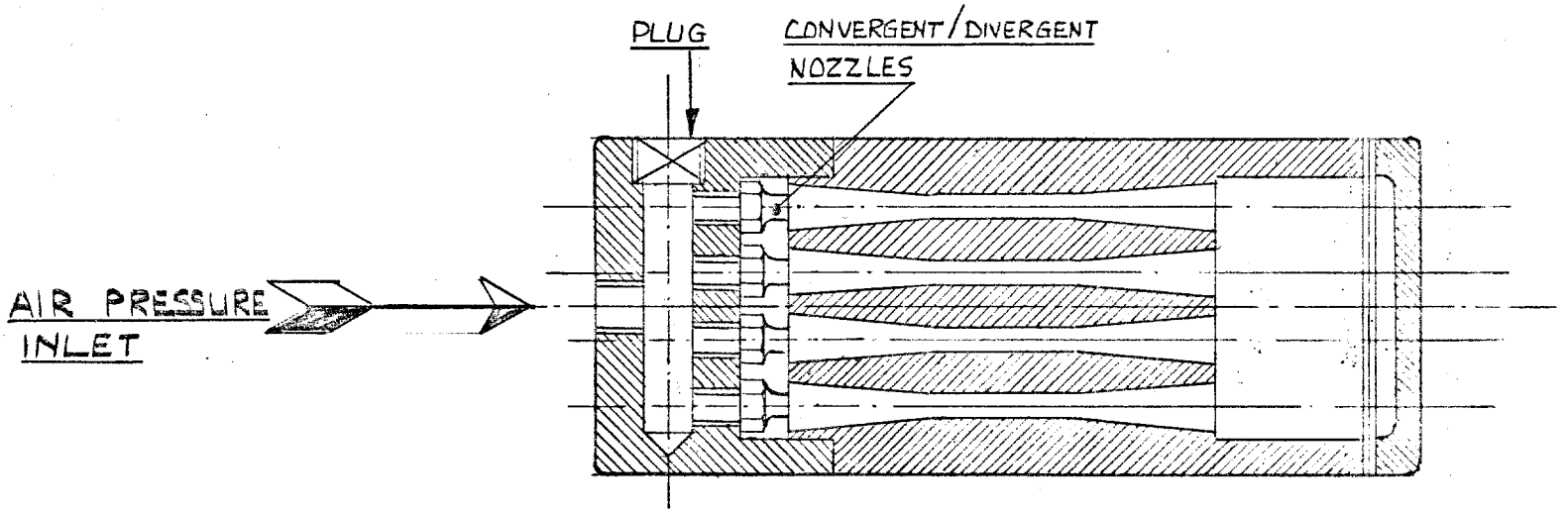
supply air to the device with a small diameter hose without suffering a significant pressure drop over long distances.

If one does not desire to drag along a high pressure line we propose the following alternative. In Figure 2 it can be seen that we provide a long FREON-22 container holding liquid Freon. By heating the container we can rapidly raise the vapor pressure of the refrigerant. When heated, the internal pressure of the Freon overcomes the 100 pound relief valve and provides high pressure gas to the device. Enough heat must be supplied to overcome the refrigeration of the expanding Freon. One also obtains the solvent action with Freon in the turbulent scrubbing stream.

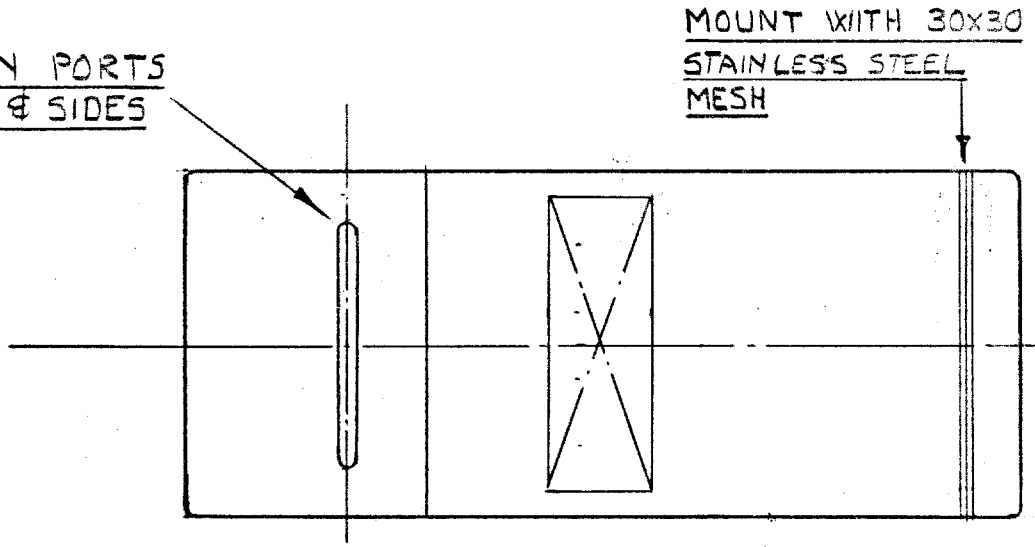
[1] VanAtta, C. M., Vacuum Science and Engineering, New York, McGraw-Hill (A65).



VIEW (A)(A)



VIEW (B)(B)



VIEW (C)(C)

VACUUM VESSEL CLEANING HEAD

FIG. 1.

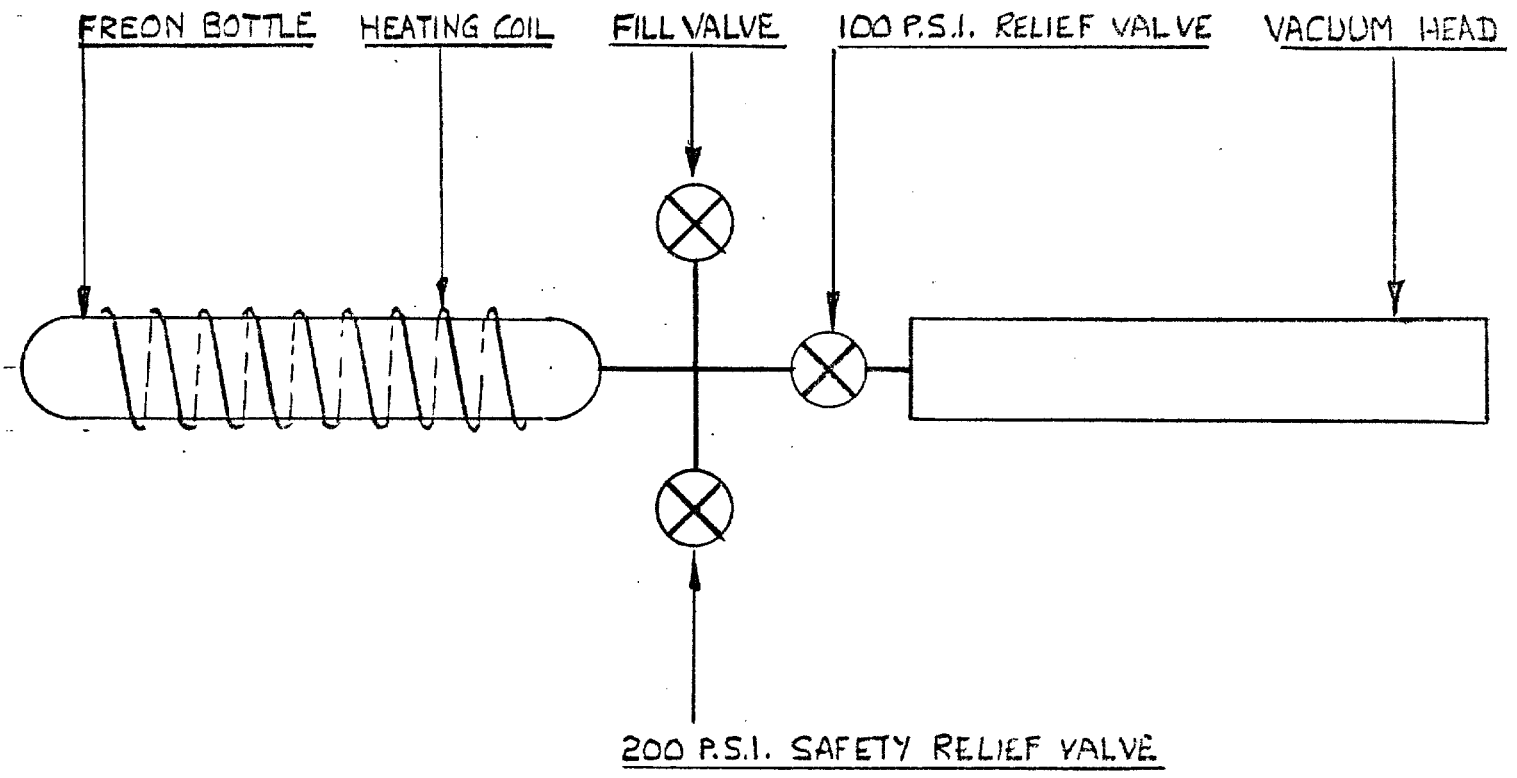

FREON BOTTLE
HEATING COIL
FILL VALVE
100 P.S.I. RELIEF VALVE
VACUUM HEAD
200 P.S.I. SAFETY RELIEF VALVE

FIG 2.